


Wayne Praskins

08/16/2001 03:49 PM

To: John Warwick <warwick@ufl.edu>

cc: Andy James <ajames@agen.ufl.edu>, Mark Marvin-Depasquale
<mmarvin@usgs.gov>

Subject: Carson River modeling 

John - I finally made some time to think about your remediation scenarios and look back at your three prior submissions. I apologize for not responding sooner. The remediation scenarios are good ones to look at, but I first want to get a better idea of how much confidence you think we can place in the model predictions (particularly for methylmercury), and discuss the value of further "baseline" simulations and further improvements to the model. I've made a few comments and listed some questions which I'd like to discuss. If you want to respond in whole or in part by email, that would be great, or we could just discuss by phone.

**Modeling Total and Methyl Mercury in the Carson River, Nevada. Model Documentation:
Detailed Output (June 1, 2000)**

- 1) p.8. Have you used any of Mark Marvin-DiPasquale's new data to refine your rate expression for methylmercury formation?
- 2) p.10, Table 1. Have you used Mark Marvin-DiPasquale's new data to refine the methylmercury formation rates defined in Table 1? (Also, is there a typo in the table? The range 00.00 - 79.25 km is listed twice.)
- 3) p.10, last paragraph. What is the reference to "particle reaction coefficients discussed in the previous section"?
- 4) p.10, last paragraph. Did you use the 4×10^{-12} diffusion coefficient for both inorganic and methylmercury? If so, how much different would you expect the two coefficients to be?
- 5) p.11 Is it correct that your efforts to relate bank concentrations to channel slope affect predicted mercury concentrations at the more upstream locations, but not at the downstream locations (e.g., Ft Churchill)? (i.e., Are mercury concentrations at the downstream locations a result of the total amount of mercury eroded from the banks and not affected by its distribution?)
- 6) Figure 7. What is the average concentration of Hgt in the fine-grained bank sediments assumed in the model? Is it about 200-250 ppm?
- 7) p12, 1st full paragraph. What is the average concentration of methylmercury assumed in the model?
- 8) p12, 1st full paragraph. You note that the calibrated methylmercury function (initially?) predicts MHg bank concentrations over two orders of magnitude higher than seen in your 10-94 bank samples. Do I understand correctly that this result led you to the concept of a threshold flow, in which you assume that methylmercury concentrations below a certain bank height are constant, and above a certain bank height are zero? Did you consider alternatives to the concept of a threshold flow? Perhaps a rate expression for methylmercury formation in bank sediments? Are there findings from your current NSF work that help explain MHg formation in bank sediments?
- 9) p.12, last paragraph. You say that your results strongly suggest that given medium flows, it is bank erosion and not diffusion that acts as the principal pathway for MHg into the water. Is it also possible that: i) methylmercury is formed in sediments isolated from the main channel; and then ii) increased flows wash through and pick up methylmercury from the previously isolated zones?
- 10) In looking at relationships between discharge and methylmercury at the Ft Churchill location from 1997 to 1999, I see a weak relationship between discharge and concentration, but a stronger relationship

between the increase in discharge from the preceding day and concentration. Have you explored this type of relationship? My analysis is crude, but could this suggest that an increase in flow uses up the methylmercury which has accumulated in bank sediments?

11) p.14, 2nd paragraph. Is the reference to Figure 1.14 meant to be Figure 10? Figure 10 is not as described in the text.

12) Calibration. Is my understanding of the methylmercury calibration sequence correct? 1) You used medium flow data from 5-16-94 to determine your two values of λ ; 2) you used high flow data from 6-10-95 to determine QT; 3) you checked the calibration using low flow data from 6-16-94, and data from 7-97, and 1997-98.

13) Figures 12, 15, and 17. Are all of these figures showing total (unfiltered) methylmercury? I see that one set of data points in Figure 15 is labeled "dissolved." Does that mean filtered samples, and are the other data points from unfiltered samples?

14) Figures 12, 15, and 17. What should I conclude from these figures about the calibrated model's ability to simulate future conditions? I see in Figure 12 a good match between measured and modeled at the more upstream locations, but overestimation by a factor of two at Ft Churchill. In Figure 15, I see a lot of variability in the measured values (e.g., concentrations from 7/23 to 7/29 vary by a factor of two). Do you expect the model to reproduce the measured variability?

15) I don't recall when I last gave you sampling results from Ft. Churchill. We have mercury results post-September 1998 from the following dates: 10/22/98, 12/03/98, 02/03/99, 03/30/00, 03/30/00, 04/14/00, 05/03/00, 05/10/00, 05/22/00, 05/22/00, 05/31/00, 07/13/00, 08/16/00, 09/13/00, 10/18/00, 11/16/00, 12/12/00, 01/23/01, 02/27/01, 03/22/01, 03/28/01, 04/26/01, 04/30/01, 05/02/01, 05/17/01, 07/03/01. Is there value in doing some verification runs with these more recent data before you move on to simulate remediation scenarios?

16) Figures 12, 15, and 17. Can you tell me qualitatively what is responsible for the shape of the modeled curves? In figure 17, for example, I'd like to understand qualitatively why concentrations decrease in Fall 97 (decrease in Q?), then remain fairly constant in late 97 and early 98 (diffusion dominates?); drop briefly in 3-98 (?); and become more variable in spring and summer 98 (flow-dependent bank erosion?). Does the conclusion you mention in your email (that bank erosion dominates at higher flows and diffusion at lower flows) apply to both inorganic and methylmercury? Over a period of a year or so, is diffusion important in terms of mass loading?

17) Figures 17 and 18. In comparing the hydrograph and modeled methylmercury concentrations in figures 17 and 18, it looks like many of the peaks in the hydrograph are damped out in the modeled methylmercury concentrations. Is that a result of your assumption of QT? I estimate that the methylmercury load transported during the March 98 storm represents more than a third of the year's methylmercury loading, but the model doesn't appear to reproduce the effect of that storm. How much of a limitation do you think that is?

18) To what extent can the model simulate the impacts on mercury transport of even larger events like the 1997 flood (which you note accounts for 96% of the bank mass eroded in a 6-year period)?

Analysis of Spatial Variation in Predicted Lateral Bank Erosion for the Carson River System, Nevada

19) I found your efforts to model erosion and deposition during overbank flow interesting, but am unclear what the impact of your efforts is on the model's ability to model mercury and methylmercury transport. I would like to discuss.

20) In the cover letter accompanying the report, you said that you were continuing to investigate alternate and possibly superior approaches. Did anything result from those efforts?

Other Questions

21) What other improvements to the model are you interested in pursuing? What processes and mechanisms and conditions do you think the model simulates well, and not so well?

John Warwick <warwick@ufl.edu>



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08/03/2001 03:00 PM

To: Mark Marvin-Depasquale <mmarvin@usgs.gov>, Wayne
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cc: Andy James <ajames@agen.ufl.edu>
Subject:

Dear Mark & Wayne,

All models upgrades are complete and mercury simulations complete. Even though we have improved significantly the model's handling of bank erosion and over bank deposit, the basic results remain mostly unchanged. At low flows (at or below 100 cfs) the dominant mechanism (by roughly an order of magnitude) for mercury transport into the water column is through diffusion from the bottom sediments. At higher flows (at or above 1000 cfs) the dominant mechanism (by again roughly an order of magnitude) for mercury transport into the water column is through bank erosion. Also, bank erosion increases significantly when the flow spills out of the main channel. These results are important as they related to the two potential remediation scenarios described below.

We are currently finalizing two potential remediation scenarios and I would appreciate any input from you prior to completing this analysis.

Scenario 1 (Upstream Storage)

Since the amount of bank erosion increases as a function of flow, and increases rather dramatically when the flows spills out of the main channel, upstream storage could be used with the goal of minimizing the magnitude and duration of overbank flow. Beyond reducing channel erosion during spring runoff, an effect that local land owners would welcome, some degree of upstream storage would also perhaps allow for a more controlled gradual reduction in flows during the spring into early summer. Such a controlled flow reduction could help cottonwood recruitment (demonstrated clearly on the Truckee River) with this resulting in overall habitat improvements (more riparian habitat and lower stream temperature due to increased shading). We are planning upon running two upstream storage alternatives.

While the creation of upstream storage is relatively easy to simulate, creating same is of course another issue. However, it is not our job to investigate the political constraints associated with attempting to create an upstream reservoir. Also, everyone should understand that you can never create enough upstream storage to completely eliminate the chance for downstream flooding. This will be clear when we investigate the impact of upstream storage on the January 1997 flood (flood of record for the Carson River). Only a huge reservoir could store all that water. Therefore, practical, economical, and political constraints will most likely preclude the development of a reservoir of the size needed to completely remove

flooding from such a severe event.

Scenario 2 (Riprap)

Bank stabilization through the place of rocks into the bank structure (riprap) is a common method. In fact we are currently investigating, as part of an ongoing NSF project, a reach of the lower Carson river that was treated with riprap following the January 1997 flood. Unlike upstream storage that would benefit all areas downstream of the dam face, riprap only reducing bank erosion is the area of application. We intend upon providing results from two alternatives involving the degree of treatment.

Again, I welcome any comments on the suggested potential remediation scenarios, along with any review comments from our prior submissions. If I hear no response we will continue and complete all work shortly. Our intention is to make final document corrections and submit the final set of documents shortly.

Sincerely,

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